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REMARKS:

This article summarizes much of the work that I have done in the last few years on oil interruptions. It may be of interest to you in connection with your work on that subject

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OIL AND NATIONAL SECURITY: An Integrated Program for Surviving an Oil Crisis

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INTRODUCTION

The dependence of the United States and its principal allies on oil from the Persian Gulf has brought with it a number of increasingly obvious and serious problems. Assessments of the extent of these problems and the merits of potential solutions have become critical national security concerns. For the past two years a group of researchers from across the nation, organized by Pan Heuristics, has studied the economic, political, and military dimensions of problems accompanying dependence on oil from the Persian Gulf.

Pan Heuristics issued its first comprehensive *Report on Persian Gulf Oil and Western Security* to the Department of Energy on November 4, 1980 (1). In that report political trends in the Persian Gulf area are reviewed by Khalilzad & Samore (2, 3); Wohlstetter and Brody describe the resulting threat to the West and potential political-military responses (4, 5); Henry Rowen & John Weyant attempt to quantify the economic effects of oil supply interruptions (6); and a number of energy policy responses to the economic problems caused by dependence on oil imports and by the threat of oil supply interruptions are explored by Rowen, Weyant, Missner, McDonald, Pittinger, Kline, Hogan, Nye, Deese, Beverly Rowen, and Gregory

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Jones (7–18). Henry Rowen, as principal investigator, was responsible for developing a succinct overview of the results of the project (19). The economic dependence of the West on Persian Gulf oil also underlies most of the military and political problems stemming from Persian Gulf dependence. Thus, this review focuses primarily on the economic problems and appropriate energy policy responses.

Two kinds of energy policies were considered as potential remedies for the economic ills resulting from Persian Gulf oil dependence. First, policies designed to directly decrease our dependence on imported oil (14, 16), which can reduce the price of world oil under normal conditions and the cost of oil supply interruptions when they occur, but will take some time (probably 3–5 years) to have significant effects. Second, policies designed to reduce the cost of oil supply interruptions once they occur. These emergency preparedness measures (e.g. stockpiling oil) involve some costs and generate no benefits under normal conditions, but could be valuable should an oil supply interruption actually occur. Given the current state of the world oil market and the long lead times required to increase the military protection of the Gulf or to reduce the level of oil imports significantly, this second type of energy policy, which could provide significant insurance against oil supply interruptions within 1–3 years, has received far too little attention. Thus, the present paper reviews various proposals for increasing the supply of—or decreasing the demand for—oil during a crisis within the framework established in the Pan Heuristics report (1).

This review cites and attempts to tie together insights from several related studies of individual vulnerability-reducing policies. However, the simplified economic framework adopted here focuses on the domestic and international interactions of the proposed emergency policies, and is, therefore, less complete in its representation of the effects of any one policy on any particular country. Consequently, there is a natural complementarity between the strategic interactions and policies identified here and the more operational recommendations that flow from the more detailed studies that are cited. One recent study of particular significance in this regard is the November 10, 1980 report on *Reducing U.S. Oil Vulnerability* from the Assistant Secretary for Policy and Evaluation to the Secretary of Energy (20). The interactions between the Department of Energy staff that prepared that report[1] and our own were frequent and fruitful. In addition, our study team overlapped with ones organized by Harvard University and the Electric Power Research Institute (EPRI) to study similar issues. The Harvard study (21) paralleled ours, but focused more on political factors and less on

[1]In particular, Lucian Pugliaresi, Thomas Neville, Roger Naill, John Stanley-Miller, Jerry Blankenship, Michael Baron, Glenn Sweetnam, and Joe Eschbach of Assistant Secretary William Lewis' staff.

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economics, while the EPRI study (22) started when ours was nearing completion, but promised to strengthen and expand upon the analytic foundations of much of the previous work in this important area.

SUMMARY

A major interruption of Persian Gulf oil supplies for an extended period, upwards of a year or more, would have a major depressing effect on the world economy given the present state of preparation of the oil importing countries. To take one case, a reduction of 9×10^6 bbl/d (millions of barrels per day) for one year, about half the oil now exported from the Persian Gulf, would have several economically destabilizing effects: the price of oil would shoot up to over $100 per barrel, oil would be released from government stockpiles, and efforts to conserve oil and to substitute other fuels and capital and labor would be undertaken. Neglecting losses from unemployment and additional losses from government administrative controls, the result would be an estimated loss on the order of 5% of GNP for the United States, 7% for Western Europe, 8% for Japan, and 8% for the oil importing, less developed countries (LDCs).

Recently, a number of actions that might greatly reduce the extent of these economic losses have been proposed. Two types of measures have been considered: those that increase supply and those that could limit demand in a crisis. On the demand side, emergency tariffs have served as a prototype; on the supply side, the strategic petroleum reserve has commanded almost all of the attention. In this paper, a number of additional supply-side measures are identified and evaluated in concert with both oil stockpiles and emergency tariffs.

The combined potential of the incremental supply possibilities for the United States in a crisis comes to the equivalent of around 2×10^6 bbl/d average for one year. The major components of this addition are: stored natural gas, fuel switching to coal by electric utilities and industry, increased oil and gas production, and more intensive operation of nuclear power plants.

Outside of the United States, the principal extra non-Persian Gulf supplies for an emergency are: increasing oil production to capacity levels (assumed to add a 10^6 bbl/d), storage of natural gas, and more intensive use of coal and nuclear plants (which is likely to require substantial coal stockpiling). This potential adds up to a total of 2.5×10^6 bbl/d for one year. It is assumed additional supplies beyond these levels would have to come from prebuilt building oil stocks.

It appears that there is sufficient flexibility within the US energy system to permit fuel substitutions on this scale; the uncertainties on this score outside of the United States are a good deal larger.

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The benefits of oil or oil-equivalent stockpiles, given an interruption say of 9×10^6 bbl/d for one year, are very large. A billion barrel stockpile would have an estimated value of \$46 billion during a 9×10^6 bbl/d interuption; with an equivalent stock held by all of the OECD countries, the saving to the United States would be \$92 billion. However, with the added supply measures, the annual cost of gaining these benefits could be much reduced; for instance, to around \$1 billion annually for the equivalent of a 500×10^6 bbl oil stock versus \$2.3 billion for an all-oil stock.

These benefits and costs can be expressed in terms of the breakeven probability of a Persian Gulf oil disruption of given size in order to justify holding given stockpile levels. An estimated annual probablility of a 9×10^6 bbl/d disruption of only 0.06 is sufficient to warrant a $1{,}000 \times 10^6$ bbl combined gas plus oil stock plus coal switching strategy; for an equivalent OECD-wide policy (as viewed from the perspective of the US economic saving) the annual breakeven probability is 0.05. (By comparison with a strategy of buying only oil stocks, these breakeven probabilities are reduced by over one half at the 500×10^6 bbl-equivalent stockpile level and by 20–25% at the $1{,}500 \times 10^6$ bbl-equivalent stockpile level).

The combination of these supply-side measures with demand ones further reduces the estimated economic loss. For the 9×10^6 bbl/d interruption, an OECD-wide emergency tariff plus these supply measures only in the United States (at the $1{,}000 \times 10^6$ bbl level) would cut US economic losses in half. If such a tariff is combined with an OECD mixed fuel stockpile, equivalent to 3 billion barrels of oil, economic losses in the noncommunist world for this scenario would be practically eliminated. Even for a full Persian Gulf closure for one year, on these supply and demand assumptions, losses would be cut in half. The annual outlays by the United States in that case would be around \$4.6 billion.

BASELINE PROJECTIONS FOR 1990

Several baseline projections (6) set the stage for the evaluation of alternative measures to reduce the vulnerability of the West to interruptions of its crude oil supply. Projections of the uninterrupted world market and output of the world's economies underly the calculation of the economic losses attributable to several baseline oil supply interruption scenarios.

The rapidly escalating prices that have characterized the world oil maket in recent months will reduce the world's demand for crude oil and increase crude oil supplies from outside of the Persian Gulf during the 1980s *relative* to the levels that would have resulted from previously prevailing price trends. But the growth of the world's economies will exert an upward pull on world oil demand that could counterbalance the downward push of the higher prices.

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Kline & Weyant (23), using a simple model of OECD oil demand incorporating both price and income effects, concluded that in the absence of new policy initiatives, if crude oil prices grow at one percent per year in real terms during the 1980s (starting from $32.00 per barrel in 1980), OECD crude oil demand in 1990 will equal or be only slightly less than the current level. That projection is consistent with a number of recent projections made by other analysts. Furthermore, depletion effects are likely to counterbalance much of the stimulating effect high prices will have on crude oil supplies from outside of the Persian Gulf during the 1980s; [2] the least cost (not price) oil in the world will continue to be that from the Persian Gulf. Thus, the baseline projection of world crude flows in 1990 (Table 1) is not much different from today's. LDC oil demand grows a bit, but is matched by a modest increase in non-Persian Gulf supply, primarily from Mexico. This result is consistent with results from ten models of the world oil market included in the Energy Modeling Forum's study on world oil (25). So, in the absence of new policy initiatives the OECD countries are about as dependent on Persian Gulf oil in 1990 as they are today.

To utilize the simple analytical framework to calculate the economic impacts of cutbacks of the supply of oil from the Persian Gulf, several benchmarking assumptions are required for a future year of interest. The year 1990 was chosen as a representative year for the economic loss calculations, and Table 2 shows the benchmarking assumptions.

Economic growth is assumed to be 5% per year in Japan and the oil importing LDCs during the 1980s, and 3% per year in the rest of the OECD. This results in a 3.4% economic growth rate for the OECD and 3.6% for importing nations outside communist areas (WOCA). Economic impacts are generally reported for three key regions of the OECD: 1. the United States, 2. Japan, and 3. other (primarily Western Europe); and the oil importing LDCs. GNP in 1990 is assumed to be $3,696 billion 1980 US dollars in the United States, $1,710 billion in Japan, $3,293 billion in Western Europe and $1,873 in the oil importing LDCs.

The market price of world crude is assumed to grow at one percent per year from $32 per barrel in 1980 US dollars in 1980, to $35 per barrel in 1980 dollars by 1990. (This, of course, assumes no further major, sustained production declines.) Emergency oil stockpiles in 1990 are assumed to be 335 million barrels in the United States, 285 million barrels in Japan, and 432 million barrels in Europe. These stockpile figures are not predictions of levels for the future; they simply enable testing the consequences of today's posture continuing into the future.

[2]See (24) and its extensive list of references for studies of US oil production supporting this projection.

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Table 1 Reference projections of WOCA oil flows in 1990[a]

	Supply (10^6 bbl/d)				
	OECD	Oil importing LDCs	Persian Gulf	Other oil exporting LDCs	Total consumption
OECD	14.0	0	15.5	8.5	38
United States	(9)	0	(2)	(6)	(17.0)
Japan	(0)	0	(4.5)	(1)	(5.5)
Western Europe[b]	(5.0)	0	(9)	(1.5)	(15.5)
Oil importing LDCs	0	3	2.5	4	9.5
Persian Gulf	0	0	3	0	3
Other exporting LDCs[c]	0	0	0	3	3
Total production	14	3	21.0	15.5	53.5

[a]We assume by 1990 no net imports or exports of oil from the Centrally Planned Economies.
[b]Shorthand for OECD less the United States and Japan; i.e. Western Europe, Canada, etc.
[c]E.g. other OPEC countries, Mexico, Egypt, Trinidad, Tobago, etc.

Additionally, it is assumed that the one-year price elasticity for crude oil demand is 0.08 in the United States and the oil importing LDCs, 0.07 in Western Europe, and 0.06 in Japan. These estimates were based on experiments with the Kline/Weyant OECD oil demand model (23). These values seem roughly consistent with the empirical evidence on the short- and

Table 2 Benchmarking assumptions

	GNP (billions 1980 dollars)		Oil consumption (10^6 bbl/d)		Oil imports (10^6 bbl/d)		Emergency stocks (10^6 bbl)	
	1980	1990	1980	1990	1980	1990	1980	1990
OECD	\$6,250	\$ 8,700	38.0	38.0	24.5	24.0	1,325	1,072
United States	\$2,750	\$ 3,696	17.0	17.0	8.0	8.0	488	355[a]
Japan	\$1,050	\$ 1,710	5.5	5.5	5.5	5.5	285	385[b]
Western Europe	\$2,450	\$ 3,293	15.5	15.5	11.0	10.5	552	432[c]
Oil importing LDCs	\$1,150	\$ 1,872	7.0	9.5	4.0	6.5	0	0
Total WOCA	\$7,400	\$10,572	45.0	47.5	28.5	30.5	1,325	1,072

[a] 100×10^6 bbl of public stocks plus 15 days of consumption in private stocks, in excess of 40 days of consumption (680×10^6 bbl) assumed necessary for working inventories.
[b]Stocks in excess of 30 days of consumption (164×10^6) assumed necessary for working inventories.
[c] 200×10^6 bbl of government mandated stocks + 15 days of consumption in private stocks in excess of 35 days of consumption (543×10^6 bbl) assumed necessary for working inventories.

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long-run demand elasticities for oil and aggregate energy.[3] The elasticity is smaller in Japan and Europe because the availability of alternative fuels (e.g. natural gas and coal) is less and because of the larger divergence between the price of crude and the price of oil products to consumers there than in the United States. This latter condition can be attributed to the very large oil product taxes in Japan and Europe and implies a lower crude oil elasticity than in the United States if the elasticity of demand for oil producers is approximately equal in the two countries.

Higher prices would, of course, stimulate some additional production by non-Gulf producers, some of which might come from small amounts of excess capacity likely to exist at any given time. Unfortunately, most of the world's spare production capacity is in the Persian Gulf area and, depending on the scenario, may be unavailable. The lead times to bring on new production capacity are long, so that only modest additional amounts of oil (or its close substitute, natural gas) can be expected in a crisis lasting one or two years. An additional possible constraint on added production is the willingness of oil exporters to increase output despite a much higher oil price. Some, for domestic or international political reasons, might be unwilling to do so.

The following assumptions about the potential for increased oil supplies from outside the Persian Gulf during a crisis follow from analysis described in (12). It is assumed that the non-Persian Gulf exporters would increase production by 0.5×10^6 bbl/d during a 9-million barrel per day interruption and by 1×10^6 bbl/d during an 18-million barrel per day interruption. The increased production would come mainly from small increases in capacity utilization in Libya and Nigeria and some increases in Mexican capacity and output. In the United States, the incremental supply is responsive to price.[4] For example, 0.3×10^6 bbl/d of additional production of oil or close substitutes is assumed to be available at a price of $100 per barrel, and 0.5×10^6 bbl/d at $200 per barrel. Of course, the 70% windfall profits tax in the United States would retard this response considerably; a world price increase of $215 per barrel would be required for producers to actually see an effective price of $100 per barrel, and price controls on natural gas would limit incentives to add to its supply. There is assumed to be no supply response in Japan or in Western Europe; there is no oil production to speak of in Japan, and the major portion of the Western European production is from the North Sea, where difficult conditions probably result in lead times of greater than one year for incremental production.

[3]See, for example, Energy Modeling Forum (26) and its extensive list of references.

[4]The short-run percentage increase in oil production in response to a one-percent increase in oil price is assumed to be .03. This parameter is known as the short-run oil supply elasticity.

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IDEALIZED INTERRUPTION ECONOMICS

Given the baseline projections, several simplifying assumptions (6) allow relatively straightforward calculation of the economic costs of oil supply interruptions. Most importantly we assume that, during the interruption, compensating monetary and fiscal policies designed to keep the nation's capital stock and labor force fully employed would be found and implemented and that there would be no inflationary costs of the interruption (e.g. 6–8). The exact specification of these policies is left to the macroeconomists (e.g 27–29). Reductions in payroll taxes and more liberal investment tax credits would help a great deal, but other policies might work as well or better.

It is also assumed that emergency energy policies fail to reduce the demand for imported oil *before* the world oil price increases to clear the market. Once the market clears, however, it is assumed that there is no attempt—either internationally or within the major oil importing nations—to reallocate supplies at the market clearing price.

The assumptions of full employment of capital and labor and no after-the-fact oil allocation rules are extremely optimistic. There is no guarantee that the required set of compensating macroeconomic policies exists, and if it does, that it will be found or implemented. Additionally, it is almost certain that equity considerations will lead to some non-price induced oil supply allocations during an interruption, especially at very high prices.

Several recent studies (27–40) have attempted to consider macroeconomic mechanisms (e.g. downwardly inflexible real wages, downwardly inflexible money wages, price rigidities, etc) that can produce these unemployment, financial market, and regulatory effects. However, there remains considerable disagreement over exactly how important each of these mechanisms will be during an oil shortage. Furthermore, the results of many of these studies are sensitive to the macroeconomic policy responses assumed: For example, the effects of small changes in the money supply can sometimes outweigh the unemployment, financial market, and regulatory effects of an oil price increase. Finally, detailed macroeconomic studies of the United States cannot be easily integrated with comparable representations of the rest of the world's economies within the context of the world oil market. Thus unemployment, financial market, and regulatory effects are not considered here. However, one common result from the detailed macro studies—that the unemployment, financial market, and regulatory effects are always positive and could be larger than the full employment effects—is factored into the interpretations of the results from the idealized interruption economics framework.

Although the optimistic assumptions adopted here lead to an understatement of the value of measures designed to cope with the adverse economic

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effects of oil supply interruptions, they allow for a much simplified description of the economics of an interruption.

A Simple Analytical Framework

This idealized view of the economics of an oil supply disruption abstracts from the complexities of the real-world response, but sets the stage for the use of a simple analytical framework to evaluate the relationships between oil availability, oil price, and economic output. But to utilize that framework, several additional simplifying aggregation assumptions must be made.

AGGREGATION ASSUMPTIONS These estimates use a simple conceptual framework for studying energy-economic interactions.[5] Although that framework is specialized to oil, disaggregated by world region and linked to various other simple analytic models in the present paper, the description of the effects of an energy tax or an energy cost increase on the economic output of an economy is solely due to Sweeney. In addition to the idealized policy response assumptions described previously, several additional assumptions underlie the implementation of this model.

First, it is assumed that actors in the economy under consideration seek to maximize economic output within the technical limitations of an aggregate production function. That production function represents aggregate economic output as depending on the economy's aggregate inputs of crude oil, capital, and labor. Additionally, it is assumed that the supplies of capital and labor are fixed and that the relationship between the supply of domestic oil and its cost does not change, assumptions that are more plausible in short-run analyses than in long-run studies.

Finally, it is assumed that the economy's demand for crude oil depends solely on its price and aggregate economic output. Higher economic output results in higher oil demand *if* the price of oil remains constant. But if the oil price increases, oil demand decreases, with a constant percentage decrease in oil demand (known as the "price elasticity" of oil demand) resulting from each percentage increase in price *if* economic output remains constant. Of course, during an oil interruption the higher oil prices that result decrease oil demand *and* economic output, with the decrease in economic output leading to further decreases in oil demand.

[5]The authors thank Professor Sweeney for his model (41), his insights into its operation, and for making his original computer code available to them. This model is closely related to the seminal energy-economy model of Hogan-Manne (42) but focuses more directly on the difference between the effects of domestic energy tax increases and increases in the price of imported oil.

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MODEL DESCRIPTION Given these assumptions, the key relationship of the Sweeney model is that, for *small* changes in the price of imported oil, the change in the Gross National Product of a particular country is equal to that price change times the level of oil imports. Mathematically, the total differential for the change in Gross National Product (G) is $dG = -E_I dP_I$ where E_I is the level of oil imports. The total decrease in GNP for *large* price changes is obtained by accumulating the GNP losses for each small price increment. Of course, as the price of oil increases, the demand for oil imports—the difference between oil consumption and domestic oil production—decreases; oil demand decreases in accordance with the aggregate demand relationship in the model, and domestic oil production is assumed to increase modestly in response to the higher prices prevailing during the interruption. A constant elasticity of supply —percentage increase in supply in response to a one percent increase in price—is assumed. Thus, to calculate the resulting decrease in Gross National Product, the level of oil imports must be updated for each small change in the price of oil imports.

This model is the essence of simplicity. Given preinterruption levels of total economic output, oil consumption, and domestic oil production for any economy, and the precut price of world oil, the decrease in economic output attributable to any increase in the world price of oil is calculated.

In this paper, the oil importing nations are grouped into four categories to permit consistent calculation of the aggregate economic effects of an oil supply interruption on the world and to isolate the effects on key oil importers. The United States and Japan are considered individually, with all other industrialized western economies included in an aggregate called "Western Europe" and the oil importing less developed countries referred to simply as "Importing LDCs."

A simple oil-economy model is calibrated to each of the four oil importing regions. The decrease in economic output in each region is calculated by increasing the world oil price by small increments and calculating the economic loss for each increment. This process is continued and the economic losses accumulated for each region until the sum of the imports of the four regions is decreased to the level of available supplies (6).

ECONOMIC LOSSES RESULTING FROM OIL SUPPLY INTERRUPTIONS

Three levels of Persian Gulf oil export interruption are examined: 3, 9, and 18×10^6 bbl/d. Each interruption is assumed to last for one year. Additionally, it is assumed that half of the available emergency stocks are released during the interruption and that the release rate during that time is constant. Thus, the release rate in Japan is $285 \div 2 \div 365 = 0.39 \times 10^6$ bbl/d.

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Given the benchmarking assumptions, the simple analytical framework can be used to project the economic losses resulting from the baseline oil supply interruptions. Figure 1 shows the economic loss projections by level of cut and importing region (6). The comparison of projected losses by importing region and level of cut identifies important relationships underlying the computations.

The effects of a 3-million barrel per day interruption for a year are, as expected, modest: they range from one to two percent of GNP across the four regions. This corresponds approximately to the cut experienced recently in Iran and is somewhat greater than that experienced in 1973–74. However, the policy response in the earlier period, at least in the United States, seems to have contributed to a greater GNP loss than this estimate.

For a 9-million barrel per day interruption, the damage is much greater; about a 5% GNP loss for the United States, 7% for Western Europe, 8% for Japan, and 8% in the Importing LDC's. Recall that these estimates assume, optimistically, a smooth economic adjustment to the sharp increase in oil prices.

For a full Persian Gulf interruption, 18×10^6 bbl/d for a year, the losses are about 13% for the United States ($465 billion), 22% for Europe, and 25% for Japan and the LDCs.

Nonlinearity with Respect to the Depth of Cut

Perhaps the most striking feature of Figure 1 is the increasing rate of loss with respect to level of the interruption in each region. The losses for the 18-million barrel per day interruption are much greater than twice those for the 9-million barrel per day interruption, and the losses for the 9-million

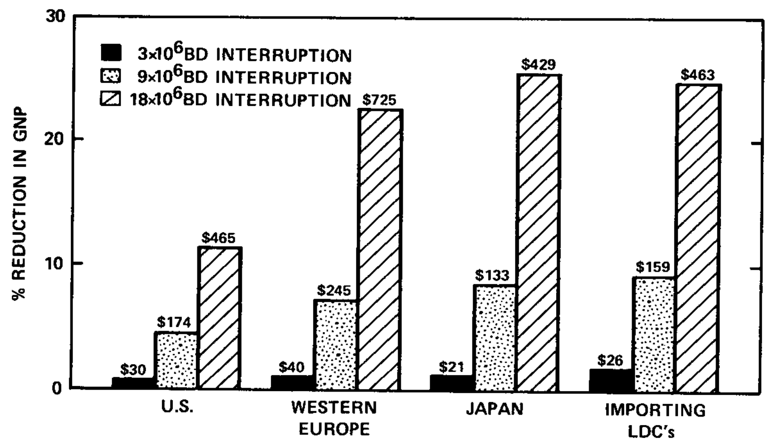

Figure 1 Percent GNP losses resulting from Persian Gulf oil supply interruptions during 1990. Numbers on top of bars are absolute GNP losses in billions of 1980 dollars.

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barrel per day cut are much greater than three times those for the 3-million barrel per day cut. This nonlinearity is a result of the substitution assumptions embedded in the models. These assumptions are drawn from the observation that in any economy that seeks to maximize output as the level of oil input is reduced, the least cost substitution opportunities will be exploited first; subsequent reductions are more costly. The increasing difficulty of substitution also implies that a greater than proportional increase in world oil price is required to clear the market in response to each successive increment to the size of the interruption. A 20% reduction in oil availability (9-million barrel per day Persian Gulf cut) leads to a threefold increase in the price of world oil and a 7% decrease in WOCA GNP, whereas a 40% reduction in oil availability (18-million barrel per day Persian Gulf cutoff) leads to a ninefold increase in the price of world oil and a 20% decrease in GNP.

Intercountry Comparisons

The economic losses vary significantly from one importing region to another, with the losses the least in the United States and the greatest in the oil importing LDCs. For a 9-million barrel per day interruption in Persian Gulf oil supplies for one year, the loss of economic output is 5% in the United States, 7% in Western Europe, 8% in Japan, and 8% in the oil importing LDCs. The smaller losses in the United States are attributable to its lower precut level of dependence and its greater potential for oil import substitution. The precut value of imported oil is 2.8% of the US economy, 4.1% of the Western European economy, 4.1% of the Japanese economy, and 4.4% of the LDC economies. Additionally, the relatively higher short-run crude oil demand elasticity in the United States and a much larger proportion of oil produced domestically results in a much higher short-run *import* elasticity than in Japan. Although the short-run oil demand elasticity assumption in the United States is 25% higher than in Japan, its import elasticity is a factor of three larger. This shows up quite clearly in a comparison of the losses for the 9-million barrel per day interruption case.

In response to the $113 per barrel oil price that results in that case, the United States is able to reduce oil imports by 36%, while only a 21% decrease can be managed in Japan. And, in fact, this leads to such a large income loss in Japan that oil consumption is actually reduced by a larger percentage there than in the United States.

The lower preinterruption dependence on oil imports and greater potential for oil import substitution in the United States might have been expected to lead to even smaller losses relative to those in the other regions. Two factors explain why the US losses are, in fact, not much smaller than those in other nations. First, the market for oil is worldwide; lack of

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substitution potential in any region leads to higher world oil prices for all. In the case of a 9-million barrel per day interruption, US oil imports drop by 2.25 X 10^6 bbl/d to 5.75 X 10^6 bbl/d. But an increase in the price of world oil from \$35 per barrel to \$113 per barrel accompanies that decrease in US imports. Thus the interruption increases the US import bill from \$102 billion to \$237 billion, or by nearly 4% of its precut level of GNP.

Differences in precut stock levels provide the other explanation for the smaller than expected interregional loss differences. During a 9-million barrel per day cut, Japan is assumed to utilize preexisting oil stocks at a rate of 0.38 X 10^6 bbl/d, or 7% of its preinterruption oil consumption/import level. This oil, which was purchased for \$30 per barrel, is now worth over \$110 per barrel. Thus, Japan saves \$11 billion, or nearly one percent of its precut level of GNP by virtue of its oil stocks. The relative size and, hence, value of the US stockpile is, given current policies, considerably less.

What Can be Done?

The view is widely held that little can be done, aside from stockpiling oil, to increase available energy supplies during an oil supply crisis. Unlike the 1950s and much of the 1960s, there is little shut-in production capacity in the United States, so that the country has been unable to buffer cuts abroad by increasing its oil production. The present level of government and government-mandated oil stocks, around 600 million barrels in the OECD countries, over minimum working inventories, although very valuable, is inadequate for a deep, long interruption.

Existing energy assets, and others that could be created, could make a very large contribution to reducing the economic impact of a major supply disruption. In considering these possibilities it is important to keep in mind that the price of oil might climb in a deep crisis to a very high price, well over \$100 per barrel. Supply and demand responses (small in the crises experienced so far) in which the price of oil moved from \$2 to \$10 per barrel and then from \$14 to \$30 per barrel (in current dollars), are likely to be much more vigorous at the very much higher prices that could occur.

EMERGENCY SUPPLY MEASURES: THE POTENTIAL FOR IMPORT SUBSTITUTION

The first column of Table 3 lists the additional supply possibilities in terms of their *separate* potential contributions in replacing imported oil (in the early 1980s) for the United States only (9–12, 15, 43). It shows the assumed average availability of these replacement fuels during the first year of a major oil crisis.

One set of potential supply increase options outside of the United States is listed the second column of Table 3 (9–12, 15). The total additional supply

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identified comes to around 4–5 X 10^6 bbl/d during the first year of an emergency in the world outside communist areas. This quantity is equivalent to about 25% of the 1979 level of exports from the Persian Gulf. (In the base case presented earlier, the availability of 1 X 10^6 bbl/d of this enhanced supply was included in the economic loss estimates for the large interruption cases.)

Several caveats apply to this aggregate estimate. First, there is a substantial range of uncertainty around each of these values (see 9–12, 15); the values shown in Table 3 assume an all-out effort and may be too optimistic. Second, there is the possibility of double counting the potential saving of oil. The combined substitution possibilities for replacing oil are likely to be less than the sum of the independently estimated savings. Third, there is a question about the net use of residual oil if these measures are capable of saving more heavy oil than is "needed" in a crisis of a given size. This "excess" saved oil would be highly useful in those end uses that have little flexibility in the choice of fuels, e.g. transportation. The question is, to what extent does the refining system have the flexibility to alter its mix of products to bring about this shift?[6] Fourth, some supply options have been omitted from this analysis; for instance, the possibility of replacing oil by enhanced natural gas production, or stored natural gas, outside of the United States.

In addition to the supply contribution from these sources, additional amounts of oil can be stockpiled in either public or private hands. (For the purposes of the analysis in this paper, no distinction is made between these two types of ownership.) The analysis here assumes that the United States and other countries have the choice of progressively adopting damage-limiting measures beginning with the least costly ones and proceeding to the

Table 3 Incremental supply potential in a crisis

Source	United States (10^6 bbl/d)	Outside United States (10^6 bbl/d)
Increased oil production	0.10	1.00
Increased gas production	0.30	0
Additional stored gas	1.00	0.30
Nuclear electric	0.30	0.20
Coal	0.70	1.00
Utilities (0.6)		
Industry (0.1)		
Total	2.40	2.50

[6]Examination of the characteristics of the refinery sector suggests that it probably has enough flexibility (44).

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most costly. Up to various thresholds, it is less costly to plan on fuel switching to coal, storing natural gas, and increasing production of natural gas and oil than it is to store additional oil. Then, as additional protection is sought, more oil is bought and stored, up to the level where the marginal cost of storing additional oil equals the expected marginal reduction in economic loss at some breakeven, probability of oil supply disruption.

There is no attempt to determine the optimum combination of fuel switching, gas storage, oil storage, etc. Instead, this paper tries to show the value of a larger array of damage-limiting measures than has been considered so far and that at least one set is potentially superior to building a large Strategic Petroleum Reserve.

After examining the possibilities for "oversaving" or double counting of oil replacement measures, we use an estimate of an aggregate increased supply potential in the United States of 2×10^6 bbl/d equivalent through these measures and 2.5×10^6 bbl/d equivalent in the non-US OECD.

The Value of Stockpiles and a US Emergency Fuel Switching Program

During an emergency, it is estimated that about 2.0×10^6 bbl/d of US oil use in the utility, industrial, commercial, and residential sectors could be switched to coal, natural gas, or nuclear sources by exploiting dual boiler capabilities, increasing power plant capacity factors, and using gas appliances more intensively. Of this total, about 1×10^6 bbl/d would come from switching to fuels whose supply, it is assumed, could be sustained throughout the crisis: coal, nuclear, and increased oil and gas production.[7] Some of this response would occur through market forces, but utility and industrial oil use switching is highly constrained by energy and environmental regulations. Unless a program to relax these regulations in an emergency is worked out in advance of a crisis, regulatory delays during the crisis could prevent technically easy and low cost opportunities (certainly relative to $100 per barrel of oil) from being implemented. Even with such a program in place it is assumed that the amount of switching would depend on the price of world oil, with the full 1-million barrel per day substitution achieved only when the world oil price reaches $100 per barrel.

The rest of the emergency supply would have to come from stocks. Adding the assumed natural gas stockpile to the current Strategic Petroleum Reserve level of about 100×10^6 bbl gives an oil-equivalent stock-

[7]On these assumptions, about 70 million tons of additional coal would be consumed in the first year, a level that could be met through increased production and depletion of existing stocks. This assumes that a strike has not depleted coal stocks in the period before the crisis and that there is no coal strike during it. For purposes of estimating economic impacts for coal stocks, the authors do not adopt the assumption used consistently for stocks of oil and gas that only one half would be consumed in a year.

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pile level of 500 X 10^6 bbl/d, the lowest level examined; other levels examined are 1000 X 10^6 bbl/d and 1500 X 10^6 bbl/d. It is assumed that additional US stocks beyond 500 X 10^6 bbl/d of oil equivalents would be composed entirely of oil.

There have been a number of excellent studies of the optimal size, fill, and drawdown rates for the US Strategic Petroleum Reserve (45–55). The focus here is primarily on the size for the reserve. In order to maintain an interpolicy and international perspective, simplifying assumptions are made about the fill and drawdown rates. It is assumed that the Strategic Petroleum Reserve is filled at a constant rate over a five-year period, and that precisely half of it will be used during a one-year oil supply interruption. Of course, the amount that is actually released will depend upon what is expected to follow; the exact depth and duration of an oil supply interruption will not be known in advance. Several recent innovative stockpile studies have explicitly incorporated these expectations within a dynamic modeling framework (45–47). In addition, some stockpile studies are formulated as games between the oil exporting and importing countries (48), including the potential sizable oil stockpiles to deter supply cutoffs. Such studies are interesting, but pertain primarily to the 1973–74 embargo type of interruption, not to those resulting from internal revolutions (e.g. Iran in 1979), interregion conflicts (e.g. the Iran/Iraq war of 1980), and Soviet control (5). Again, the complementarity between those studies and the framework adopted here is obvious; they require inputs on international interactions and the effects of other emergency policies and we require inputs on the effects of expectations.

Two distinct benefits accrue from releasing stockpiled oil in a crisis (7). One is a reduction in the world oil price; this benefits *all* oil importing nations. The other is the capital gain from oil sold at a much higher price than its purchase price; this benefit accrues only to the owner of the stockpile. Similarly, emergency fuel switching programs will reduce the world oil price during an oil supply interruption, and could also produce capital gains if the cost of fuel switching is less than the world oil price that would result without it.

Figure 2 shows that in the absence of any other emergency policies a fuel switching program without adding to the present Strategic Petroleum Reserve level would be worth \$4 billion during a 3-million barrel per day world oil supply interruption, \$40 billion during a 9-million barrel per day world oil supply interruption, and \$99 billion during an 18-million barrel per day world oil supply interruption (in this last case a \$465 billion loss would be reduced to \$366 billion). The existence of this switching capability reduces the value of having an oil, or oil-equivalent, stockpile, although for large interruptions this value remains great. Figure 2 shows that this fuel switching capacity reduces the value of a one-billion barrel oil stock by \$4 billion,

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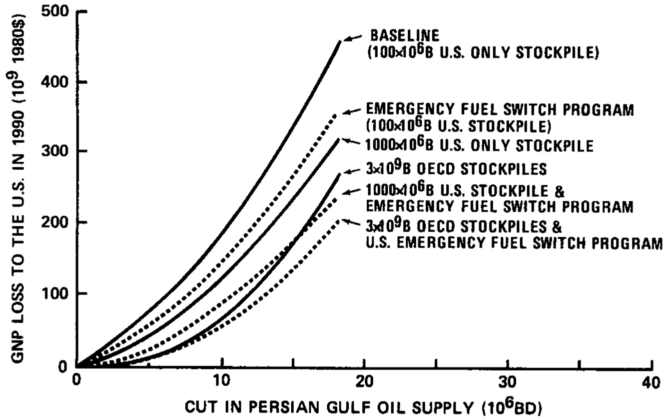

Figure 2 Reduction in US GNP losses attributable to US and OECD emergency supply policies in billions of 1980 dollars.

$13 billion, and $15 billion for the 3, 9, and 18-million barrel per day cuts respectively. For the deeper cuts, even with the assumed level of fuel switching, the value of a one-billion barrel oil stock remains large, with a GNP saving of $115 billion for the biggest cut.

It is also true that releases from a one-billion barrel US oil stockpile, which would limit the increase in the world oil price during a crisis, would reduce the value of the fuel switching program (by $3 billion, $13 billion, and $15 billion for the 3, 9, and 18-million barrel per day cuts respectively). Again, the remaining value of fuel switching is large, especially for the deepest crisis, $84 billion. Figure 3 shows the equally impressive benefits to the other OECD nations resulting from the OECD-wide emergency oil substitution program. Additionally, the interruption costs calculated here

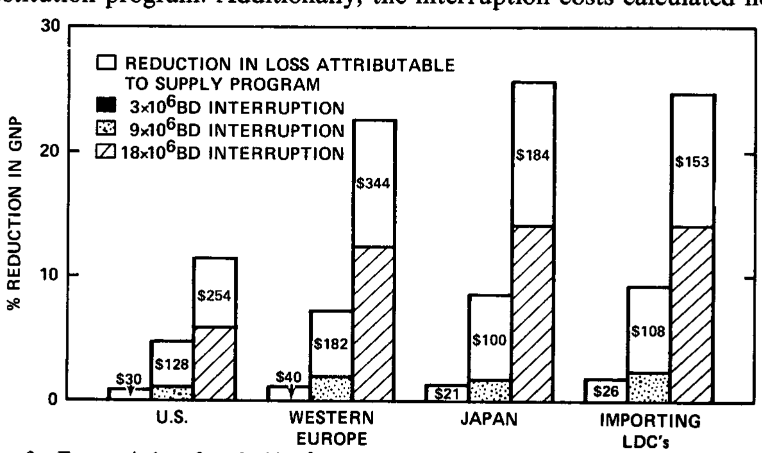

Figure 3 Economic benefits of 3 X 10^9 bbl OECD stockpiles and US emergency fuel switch program. Reductions in GNP losses are in billions of 1980 dollars. Absolute baseline losses are given in Figure 1.

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ignore unemployment and inflationary costs that would undoubtedly make these supply-side oil emergency measures even more valuable.

Multifuel Stockpiles and Their Costs

Four components contribute to the cost of oil stockpiles: 1. physical storage cost, 2. holding cost, 3. the cost of higher world oil prices during stockpile acquisitions, and 4. a credit for the capital gain on the stockpiled oil (7). If it is necessary to buy additional coal to ensure its availability in a crisis, there would probably be little increase in its price, and if gas can be acquired that would otherwise not be marketed in the next few years (say from Canada), there would be only a small increase in its price as well. In any case, the authors assume no price increase effect for these two fuels. Additionally, there is already a large amount of gas in storage for exceptionally cold winters (11); some of this could be in excess supply in an average year and be usable in an emergency.

It is assumed that in an emergency the United States can substitute gas for one million barrels per day of oil use, that one half of this gas is purchased at $5.00 per million cubic feet (Mcf), and that the annual storage cost per barrel of oil equivalent would be $3.80.[8] Thus, the United States could achieve a 365-million barrel oil-equivalent stockpile at an annual cost of only $3.80 X 365 million X 0.5 (i.e. $700) million annually. This is nearly $1.5 billion per year cheaper than an equivalent oil-only stockpile (15). This result is attributable solely to a smaller increase in the world oil price effects in the former case. In fact, the assumed billion barrels of oil equivalent abroad that is required to match a 500-million barrel US stockpile is made up largely of coal. In this case, there would be no upward pressure on the world oil price at all, with the stockpile cost to the US being independent of the stockpile buildup elsewhere. Because of the limit on the increase of the amount of gas that could be accommodated in the existing gas transportation and distribution system and substituted for oil uses, it is assumed that additional US petroleum stocks would have to be in the form of oil.

The Breakeven Analysis

How do these lower stockpile costs affect their desirability? Table 4 shows the stockpile breakeven probability analysis on the payoffs, given a 9-million

[8] In an average year about one trillion cubic feet of natural gas could be extracted from existing stocks beyond seasonal demands in an emergency; therefore, this gas does not have to be purchased. The annual cost of storing added gas bought at $5.00 per Mcf would come to about $3.80 per barrel of oil equivalent. This assumes a 6% real discount rate, new storage sites whose cost is $1 per Mcf of gas stored, annual operating costs of $.06 per Mcf, and an additional 25% bought as cushion gas needed to replenish depleted gas fields assumed to be used as added storage sites.

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Table 4 Comparison of US breakeven probabilities for oil stockpiles (with and without emergency fuel switch program) for a single one year world oil supply interruption of 9×10^6 bbl/d in 1990

	Type of stockpile	Coal/nuclear fuel switch program	US only stockpiles: 500 10^6 bbl/d	US only stockpiles: 1,000 10^6 bbl/d	US only stockpiles: 1,500 10^6 bbl/d	With equivalent OECD stockpiles: 500 10^6 bbl/d	With equivalent OECD stockpiles: 1,000 10^6 bbl/d	With equivalent OECD stockpiles: 1,500 10^6 bbl/d
Reduction in US GNP loss resulting from interruption (billions of 1980 dollars)	Oil only	No	28	59	87	62	118	159
	Gas/Oil	No	28	59	87	62	118	159
	Gas/Oil	Yes	26	46	66	50	92	125
Annual stockpile cost to US (billions of 1980 dollars)	Oil only	No	2.3	4.9	7.6	3.6	8.7	14.2
	Gas/Oil	No	0.9	3.4	6.1	0.9	4.6	10.7
	Gas/Oil	Yes	0.9	3.4	6.1	0.9	4.6	10.7
Breakeven probability	Oil only	No	.082	.083	.087	.058	.074	.089
	Gas/Oil	No	.032	.058	.070	.014	.039	.067
	Gas/Oil	Yes	.03	.074	.092	.018	.050	.086

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barrel per day interruption, from oil stockpiles, and for multifuel stockpiles. In the absence of the emergency fuel switching program, US gas plus oil stockpiles always have a lower breakeven probability than the oil-only stockpiles; the benefits are the same and the costs lower. In fact, the gas increment to the existing Strategic Petroleum Reserve stockpile is justified by a one in thirty (.032) annual probability of a 9-million barrel per day interruption. The presence of the fuel switching program decreases the benefits of stocks and increases the breakeven probability by a little, with the effect increasing with growing stockpile size. This is because fuel switching (largely to coal) costs very little, while stockpiling oil and gas costs more for equivalent benefits.

The existence of equivalent stockpiles also in the other OECD countries approximately doubles the benefits of a 500×10^6 bbl stock in the United States; this reduces the breakeven probability associated with a gas plus oil stockpile of that size for the United States to about .014 (i.e. a 1 in 70 chance per year of an interruption of 9×10^6 bbl/d). For larger stocks, both benefits and costs grow, but because the costs climb more rapidly, the breakeven probability justifying these larger stocks is higher than when the United States builds the stocks on its own. But it takes no more than a .07 annual probability to justify an OECD oil-equivalent stockpile of 4–5 billion barrels.

Measures designed to provide substitutes for oil imports during a crisis appear to be extremely valuable. Furthermore, unlike complete reliance on a strategic petroleum reserve, the use of other complementary options—e.g. gas stockpiles, increased coal and nuclear electricity generation, emergency fuel switching in industry—would require little investment before the crisis emerges, which minimizes the burden on the federal budget.

In addition to these import-substitution measures, there are several options for reducing oil import *demand* during a crisis. Many emergency allocation, rationing, and tax schemes have been proposed, but because of their superior economic efficiency emergency oil import tariffs are considered as a prototype.

DEMAND-SIDE OPTIONS: EMERGENCY TARIFFS AS THE PROTOTYPE

A sudden supply interruption is equivalent to a rapid leftward shifting of the supply of oil production as a function of price. Because, in the short run, consumers cannot easily reduce their demand for oil, the result is a large increase in the price of oil and a large increase in the transfer of wealth to the remaining producers of oil. If importers act to reduce their demand beyond that induced by the change in the world price, they could save much

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of the wealth that would otherwise be transferred to the remaining producers.

This demand reduction can result from either the imposition of a tariff on imported oil, taxes on oil production, or, almost equivalently, a quota. Recent fashion, as expressed in international Western summit meetings, has been to announce (so far nonbinding) import quotas. As students of elementary economics know, setting physical quotas is nearly equivalent to setting prices.[9] The issue is whether the importing nation can retain a substantial amount of huge wealth that will otherwise be transferred to the remaining oil producers if they do not act to limit demand?

The idea of imposing an oil import tariff during an emergency has only recently been proposed. Figure 4 illustrates the logic of an emergency tariff. In Figure 4a, the world oil market clears and a tremendous amount of additional payment is made to the remaining oil producers. In addition, there is a "deadweight" loss in the domestic economy, as many of those who once purchased oil at a price much less than its value to them can no longer get it. Figure 4b shows that an emergency tariff raises the domestic oil price considerably during the crisis; this increases the deadweight loss but reduces the world oil price and the magnitude of the additional wealth transfer considerably. And the total cost of the interruption (the shaded area in the two diagrams) is reduced.

Costs and Benefits of Tariffs and Quotas

For example, in the absence of demand-reducing action by importers (and leaving aside the effect of stocks of oil and other fuels), a 9-million barrel per day interruption would result in the world oil price increasing to about \$113 per barrel. If the OECD, acting in concert, were to impose a tariff of \$100 per barrel, the result would be a lower world oil price of \$83 per barrel,

[9]The difference, which may not be a trivial one, especially in the long run, is that the tariff presents foreign suppliers with a demand *schedule,* whereas a quota presents foreign suppliers with a specific target *value,* i.e. the stipulated amount allowed into the importing country. A wealth maximizing oil exporter facing the quota knows exactly where to set his production, at the permitted level. He has no incentive to set any lower price. On the other hand, when faced with a tariff schedule, an increase in price further reduces demand and, because of the effect of those demand reductions on his oil revenues it will not, in general, be in his best interest to increase the price as much as he would when the quota sets a limit on the level of demand. The assumption made here is that during a crisis the increase in the wealth transfer to the remaining oil producers is so enormous and the political pressures so great they they would not have sufficient motivation or time to fine-tune their pricing policy away from that prescribed by the very strong market forces that would exist. The fact that the interrupted suppliers would be those most influential in price setting in the past, those in the Persian Gulf, lends credibility to this assumption.

Tariffs and quotas are analytically identical if the quota is continuously adjusted. However, institutional practices prescribe intermittent decisions.

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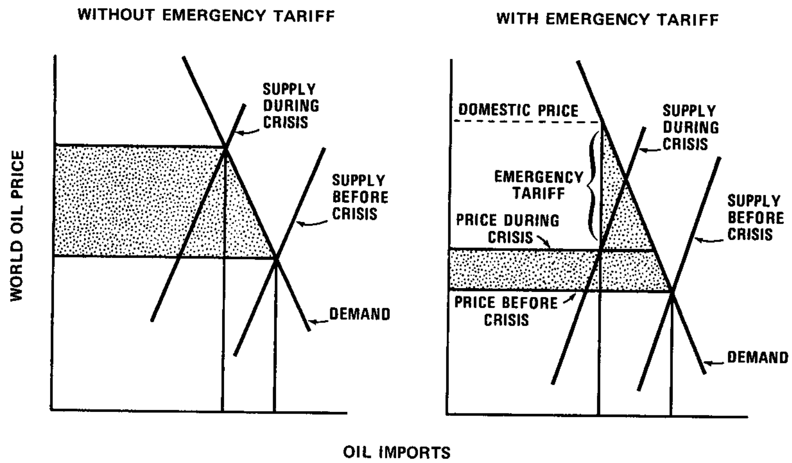

Figure 4 Effect of emergency tariffs on world oil market during a supply interruption.

a $57 billion net saving to the US economy, and a $188 billion saving to the OECD as a whole. The rest of the world would also benefit from this action.[10]

The saving would be much smaller if the United States were to act alone in reducing demand in this way. If a tariff of $104 per barrel were to be imposed by the United States only, the result would be a net saving to the country of $15 billion and a saving to the OECD as a whole of $44 billion. A US tariff of $104 per barrel in this case would be optimal.

Comparison of Emergency Quotas and Tariffs

A tariff is a tax that would be paid on each barrel of imported oil, and its revenues could be returned to the domestic economy instead of being sent to the oil producers. The increase in the price of oil paid by domestic consumers eliminates some uses of oil that were worth more than the preinterruption price, but not as much as the price during the interruption. The higher energy price also decreases the value of the other factors of production. The imposition of the tariff does not avoid this inevitable part of the economic loss resulting from the interruption.

It is impossible to reduce imports in a more efficient way than by impos-

[10]In this case, a uniform tariff of $258 per barrel would result in the maximum saving in OECD GNP ($277 billion) during the 9-million barrel per day interruption. However, a tariff of that size would produce a smaller reduction in US GNP ($53 billion) than the optimal OECD tariff, primarily because of its greater import substitution potential; the increase in the deadweight loss in the United States starts to exceed the decrease in the wealth transfer to oil producers at a lower tariff level than it does in Japan or Western Europe.

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ing a tariff. As the tariff is increased, oil is progressively removed from its least valuable remaining uses. Price controls and allocation rules will always cost more unless the oil is allocated in exactly the same way as the tariff would allocate it; if any use that is cut off has a higher value than one that continues to be satisfied during the interruption, the economy pays a higher price than it otherwise would. In practice the information requirement of such an allocation system renders it less efficient. (However, an allocation system may be perceived as more equitable, in which case a further loss of GNP is accepted as the price for such fairness.)

The efficiency of the tariff as a means of reducing imports commends it as an emergency measure. Any other demand-reducing measure will, at best, have the same value via reductions in the world oil price, but will cost at least as much to implement.

How the Cost of Imposing Emergency Tariffs is Calculated

A tariff on oil imports creates a gap between the world oil price and the price domestic consumers pay for oil, which leads to a reduction in consumption and in import demand, which can lead to a reduction in the world oil price. But this reduction in demand is not free.

Another basic result from the use of Sweeney's model (41) is employed to calculate the cost of imposing the tariff. As the tariff is increased, the decrease in the value of the oil exceeds the decrease in the cost of importing oil by precisely the size of the tariff. Thus the cost of increasing the tariff by a small amount will be the product of the resulting decrease in imports and the size of the tariff at that point. The total cost of imposing a tariff of a given size will be the sum of the costs of the requisite number of successive small tariff increases. For example, the calculations show that an emergency tariff of $258 per barrel applied by all of the OECD countries during a 9-million barrel per day oil supply interruption would cost the United States $103 billion in deadweight losses and reduce US oil demand by 3.6 million barrels. A $258 per barrel tariff during a 9-million barrel per day world oil supply interruption is certainly possible. Such a tariff would reduce the world oil price from $113 per barrel to $46 per barrel, which would reduce the wealth transfer from the United States during the interruption by almost $70 billion, and the total cost to the United States (increase in wealth transfer plus deadweight loss) attributable to higher world oil prices during the interruption by $156 billion. Thus, the United States would save $156 billion minus $103 billion, or $53 billion, and the OECD as a whole would save $277 billion, or about half of the total cost of the interruption of 9×10^6 bbl/d. This conclusion, and these numerical estimates, obviously depend on the response of the remaining oil producers

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to the importers' actions. This estimate assumes that the remaining producers hold production constant; if they have other goals, a lower tariff is likely to be optimal. Additionally, the higher domestic prices resulting from the imposition of the tariff could lead to additional inflationary costs. Consequently, the *a fortiori* argument concerning inflationary and unemployment costs used in the evaluation of the emergency supply options does not hold here. However, compensating monetary and fiscal policies in concert with a well-designed program to rebate the tariff revenues to consumers could enable the benefits calculated here to be achieved.

Emergency Tariffs in all OECD Countries

If all the OECD nations impose emergency tariffs, the effect on the world oil price during the interruption will be much greater than that which results from unilateral action by the United States.

Uniform OECD emergency tariffs are calculated in much the same way as US emergency tariffs. A uniform emergency tariff is assumed to be imposed in the United States, Japan, and Western Europe. This tariff reduces demand during the interruption and results in lower world oil prices during the baseline interruptions. The imposition of the tariff and the subsequent world oil price increase both cost the oil importing economies. The total reduction in the wealth transfer to the oil exporting nations leads to a lower total cost than in the baseline interruption where no tariffs are assumed. An optimal OECD emergency tariff is defined as the tariff that minimizes the total cost of the interruption to the OECD as a whole.

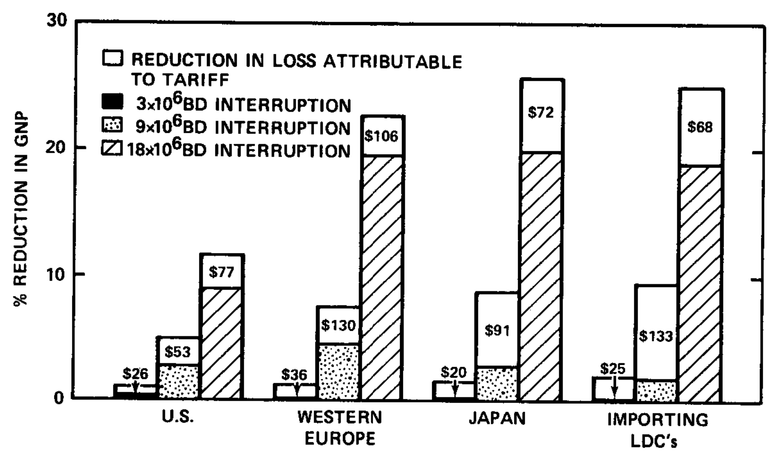

Figure 5 Economic benefits of optimal OECD emergency tariffs. Reduction in GNP losses are in billions of 1980 dollars. Absolute baseline GNP losses are given in Figure 1.

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Figure 5 shows the benefits of optimal uniform OECD emergency tariffs relative to the costs of the baseline interruption. These benefits are much greater than those attributable to a tariff imposed by the United States acting alone.

For the smallest interruption case, 3 X 10^6 bbl/d economic losses are almost eliminated. It shows not only the large saving for the OECD countries but also that the free ride for the oil importing LDCs is significant. They gain all the benefits of the lower world oil price resulting from the OECD tariff but do not pay the cost of imposing a tariff on their own oil imports. This leads to the question of whether mandatory restrictions on LDC imports in a major world energy crisis would significantly increase the value of demand-reducing measures elsewhere.

COMBINED VALUE OF SUPPLY AND DEMAND MEASURES

Does the existence of an emergency oil/gas/coal supply program greatly reduce the value of an emergency oil demand reduction program and vice versa, or are the values of the two types of contingency plans roughly additive? It would be surprising if the value of the simultaneous application of the two kinds of programs equalled the sum of their individual benefits. Each is focused on directly reducing the size of the economic loss to the United States and indirectly reducing the size of the world oil price and economic losses during the interruption to everyone.

A 1,000-million barrel US gas and oil stockpile[11] and emergency fuel switch program is worth \$87 billion during a 9 X 10^6 bbl/d interruption. If an equivalent number of days of oil import coverage is provided by coal, gas, and oil stocks outside the United States, the value of the US emergency supply program to the United States grows from \$87 billion to \$128 billion. Figure 6 shows that OECD-wide emergency tariffs reduce that value to \$102 billion. On the other hand, the existence of the OECD-wide emergency supply program reduces the value of the OECD emergency tariff to the United States from \$53 billion to \$27 billion. A smaller tariff is required in this case than with the US-only emergency supply program. The United States would derive a greater fraction of the benefits of that OECD tariff. Thus, the OECD supply program increases the value of an optimal OECD

[11]The existing Strategic Petroleum Reserve level of about 100 X 10^6 bbl was assumed. This stock plus the target level for the gas stockpile comes to around 500 X 10^6 bbl of oil equivalent. The remaining 500 X 10^6 bbl would consist of new oil stocks.

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emergency tariff to the United States relative to a US-only emergency supply program.

The most important message derived from Figure 6 is that the combination of the supply measures the authors propose in all of the OECD countries, together with an OECD-wide emergency tariff, can almost eliminate economic losses in the United States, Western Europe, and Japan from a 9-million barrel per day interruption.

These measures would also, of course, greatly reduce losses from a full Persian Gulf interruption. The combined effect of OECD emergency tariffs and a three billion barrel oil-equivalent stockpile would be to reduce economic losses in the United States by 60% and in Japan, Western Europe, and the oil importing LDCs by even more. The resulting losses (aside from possible macroeconomic effects) would be held to less than 10% of GNP for all regions and to around 5% for the United States. In any case, these losses are less than one half of the loss without the protection. And the cost of such a program to the United States would be around five billion dollars annually.

In summary, the value of emergency supply and demand measures accumulates. The existence of emergency demand-limiting programs reduces the value of emergency supply programs by less than emergency supply programs reduce the value of emergency demand programs, but even then significant benefits remain. This suggests the efficacy of a balanced and integrated emergency oil supply and demand program.

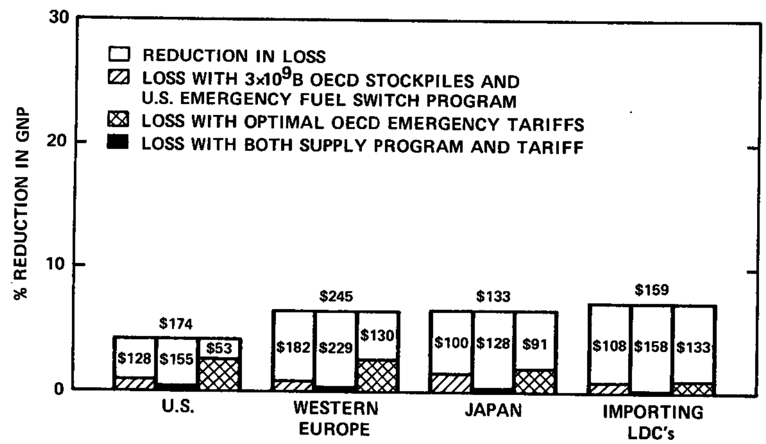

Figure 6 Comparative benefits of OECD emergency supply program and OECD emergency tariffs during a 9 X 10^6 bbl/d oil supply interruption. Reduction in GNP losses are in billions of 1980 dollars. Absolute baseline GNP losses are given in Figure 1.

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Literature Cited

1. Pan Heuristics. 1980. *Report on Persian Gulf Oil and Western Security.* Report to the US Dept. Energy. Marina Del Rey, Calif: Pan Heuristics. (18 Chs.)
2. Khalilzad, Z. 1980. *Turmoil in the Persian Gulf.* See Ref. 1, Ch. 2. 29 pp.
3. Samore, G. S. 1980. *The Persian Gulf and energy security in the 1980s.* See Ref. 1. Ch. 3. 127 pp.
4. Wohlstetter, A. 1980. *Protecting Persian Gulf oil: U.S. and Alliance Military Policy.* See Ref. 1, Ch. 4. 89 pp.
5. Brody, R. 1980. *The implications of Soviet control of Persian Gulf Oil.* See Ref. 1, Ch. 5. 29 pp.
6. Rowen, H. S., Weyant, J. P. 1980. *The economic impacts of oil supply interruptions.* See Ref. 1, Ch. 6. 37 pp.
7. Rowen, H. S., Weyant, J. P. 1980. *The value of oil stockpiles.* See Ref. 1, Ch. 7. 32 pp.
8. Missner, S. L. 1980. *Private sector petroleum stockpiling.* See Ref. 1, Ch. 8. 31 pp.
9. Rowen, B. 1980. *Coal in an oil crisis.* See Ref. 1, Ch. 9. 134 pp.
10. Jones, G. S. 1980. *Increased nuclear power in an oil crisis.* See Ref. 1, Ch. 10. 19 pp.
11. McDonald, R. 1980. *The potential for storing natural gas.* See Ref. 1, Ch. 11. 25 pp.
12. Pittinger, L. 1980. *Emergency petroleum production capacity outside the Persian Gulf.* See Ref. 1, Ch. 12. 91 pp.
13. Rowen, H. S., Weyant, J. P. 1980. *Reducing oil demand in an emergency.* See Ref. 1, Ch. 13. 31 pp.
14. Hogan, W. W. 1980. *Import Management and Oil Emergencies.* See Ref. 1, Ch. 14. 65 pp.
15. Rowen, H. S., Weyant, J. P. 1980. *An integrative program for surviving an oil crisis. See Ref. 1, Ch. 15. 29 pp.*
16. Kline, D., Weyant, J. P. 1980. *Reducing Persian Gulf dependence over time.* See Ref. 1, Ch. 16. 92 pp.
17. Deese, D. A. 1980. *The oil-importing developing countries.* See Ref. 1, Ch. 17. 47 pp.
18. Nye, J. S., Deese, D. A. 1980. *International cooperation and energy security policies in oil-importing nations.* See Ref. 1, Ch. 18. 87 pp.
19. Rowen, H. S. 1980. *Overview.* See Ref. 1, Ch. 1. 62 pp.
20. Assistant Secretary for Policy and Evaluation, US Dept. Energy. 1980. *Reducing Oil Vulnerability: Energy Policy for the 1980s,* Rep. No. DOE/PE-0021. An analytical report to the Secretary of Energy. Wash. DC: DOE
21. Deese, D. A., Nye, J. S., eds. 1981. *Energy and Security* Cambridge, Mass: Ballinger. 424 pp.
22. Plummer, J. L. 1981. Methods for measuring the oil import premium and the oil stockpile premium *Energy J.* 2(1): 1–18
23. Kline, D., Weyant, J. P. 1979. *OECD Oil Demand Projections.* Stanford Int. Energy Program, Stanford Univ., Calif.
24. Energy Modeling Forum. 1981. *US Oil and Gas Supply.* Vols. 1, 2. Stanford Univ., Calif: EMF
25. Energy Modeling Forum. 1981. *World Oil.* Vols. 1, 2. Stanford Univ., Calif: EMF
26. Energy Modeling Forum. 1980. *Aggregate Energy Demand Elasticity.* Vols. 1, 2. Stanford Univ., Calif: EMF
27. Mork, K. A., Hall, R. E. 1980. Energy prices and the U.S. economy in 1980–81. *Energy J.* 1(2):41–53
28. Mork, K. A., Hall, R. E. 1980. Energy Prices, Inflation, and Recession. *Energy J.* 1(3)31–63
29. Pindyck, R. S. 1980. Energy price increases and macroeconomic policy. *Energy J.* 1(4):1–20
30. Curtis, W. P. 1979. *Macroeconomic Effects of Petroleum Supply Interruptions.* US Dept. Energy, Energy Inf. Adm., Wash. DC: DOE
31. Eckstein, O. 1979. Macroeconomic Analysis of Price Shocks. *Presented at a Conf. on Energy Prices, Inflation, and Econ. Activity,* MIT Energy Lab. Working Pap. No. MIT-EL79-065WP. Cambridge, Mass: MIT Energy Lab. 18 pp.
32. Eckstein, O. 1979. *Macroeconomic policy responses to energy price shocks.* See Ref. 31. 8 pp.
33. Gramlich, E. M. 1979. Macro policy responses to price shocks. In *Brookings Papers on Economic Activity:* pp. 125–89. Wash. DC: Brookings Inst.
34. Nordhaus, W. D. 1980. The macroeconomic cost of microeconomic shocks. In *Brookings Papers on Economic Activity,* pp. 341–88. Wash. DC: Brookings Inst.
35. Organization of Economic Cooperation and Development. 1980. The impact of oil in the world economy. In *OECD Economic Outlook,* No. 27: pp. 114–30. Paris: OECD
36. Probyn, D., Empey, W., Wyss, D. 1980. OPEC III and the world economy. In *Data Resour. Rev.* 4(1):1.16–1.19
37. Smith, J. R. 1979. Reflation: Recession and Inflation in the United States, its

Approved For Release 2007/04/11 : CIA-RDP83B00140R000100010031-0

Approved For Release 2007/04/11 : CIA-RDP83B00140R000100010031-0

Causes and Influences from the Foreign Sector. In *Economic Notes by Monte Dei Paschi,* 8(3):88–94

38. Solow, R. M. 1978. What to do macroeconomically when OPEC comes. *NBER Conference on National Expectations and Economic Policy,* pp. 249–67. Chicago: Univ. Chicago Press
39. Thurmar, S., Berner, R. 1979. *Analysis of Oil Price Shocks in the MPS Model.* See Ref. 31. 25 pp.
40. US Dept. Energy, Economic Regulatory Administration. 1979. *Standby Gasoline Rationing Plan,* Rep. No. DOE/ERA-0046. Wash. DC: DOE
41. Sweeney, J. L. 1979. Energy and economic growth: A conceptual framework. In *Directions in Energy Policy: A Comprehensive Approach to Energy Resource Decision Making,* ed. B. Kursuoglic, A. Permutter, New York: Academic
42. Hogan, W. W., Manne, A. S. 1977. Energy-economy interactions: The fable of the elephant and the rabbit? In *Energy and the Economy.* Energy Modeling Forum Forum Rep. No. 1, Vol. 2. Stanford Univ., Calif: EMF
43. Schlesinger, B. 1980. *Potential of Increased Gas Supply Capability to Reduce Impacts to the U.S. Economy of a Major Oil Supply Disruption.* Arlington, Va: Am. Gas Assoc.
44. Purvin & Gertz, Inc. 1980. An Analysis of Potential for Upgrading Domestic Refining Capacity. Arlington, Va: Am. Gas Assoc.
45. Teisberg, T. J. 1980. *A Dynamic Programming Model of the U.S. Strategic Petroleum Reserve.* Energy Lab. Mass. Inst. Technol., Cambridge, Mass.
46. Pugliaresi, L., Sweetnam, G. 1980. *Strategic Petroleum Reserve Analysis.* US Dept. Energy. Wash. DC: DOE
47. Chao, H., Manne, A. S. 1980. *Oil Stockpiles and Import Reductions: A Dynamic Programming Approach* Palo Alto, Calif: Electric Power Res. Inst. (Draft)
48. Balas, E. 1979. *The Strategic Petroleum Reserve: How Large Should it be?* Graduate School Ind. Admin., Carnegie-Mellon Univ., Pittsburgh, Penn.
49. Holt, B. J., Berkman, M. 1980. *An Evaluation of the Strategic Petroleum Reserve.* Congressional Budget Office, US Congress. Wash. DC: GPO
50. Blankenship, J., Barron, M. J., Lane, W. O., Eschbach, J., Bower, J. L. 1980. *The Energy Problem: Costs and Policy Options.* US Dept. Energy, Assistant Secretary for Policy & Evaluation, Office of Oil Policy. Wash. DC: DOE
51. Coplon, G. V. 1979. *DOE Analysis of the Appropriate Size of the Strategic Petroleum Reserve.* US Dept. Energy, Assistant Secretary for Policy & Evaluation, Office of Emergency Preparedness. Wash. DC: DOE
52. Borison, A. 1980. *Strategic Petroleum Reserve Program: the Policy Questions.* Palo Alto, Calif: Applied Decision Analysis
53. Butler, G. D., Kilgore, W. C. 1979. *Petroleum Supply Vulnerability, 1985.* US Dept. Energy, Energy Information Administration, Office of Integrative Analysis. Report No. DOE/EIA-0102/44. Wash. DC: DOE
54. Controller General of the United States. 1979. *Factors Influencing the Size of the U.S. Strategic Petroleum Reserve,* Report to Congress No. ID-79-8. Wash. DC: General Accounting Office
55. Novicky, E. R. 1979. *An Assessment of the Macroeconomic Benefits of the Strategic Petroleum Reserve.* Scientific Time Sharing Corp. Management Technol. Div. Bethesda, Md: STSC

Approved For Release 2007/04/11 : CIA-RDP83B00140R000100010031-0